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TAYLOR, EARLE N				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/677,166

Applicant(s)

UZOH ET AL.

Examiner

EARL N. TAYLOR

Art Unit

2818

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 October 2003 to 07 January 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-62 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-62 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/S5108)
- 4) ☐ Interview Summary (PTO-413)
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____
- Paper No(s)/Mail Date _____

DETAILED ACTION

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, "recesses" of claims 16, 38 and 57 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: "4".

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner,

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the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

Claims 1 and 16 are objected to because of the following informalities:

Claim 1 recites "... photoresist layer over **aid** plating seed layer ..." and should read "... photoresist layer over **said** plating seed layer ...--

Claim 16 recites "... horizontal portions between **aid** ..." and should read "... horizontal portions between **said** ...--

Appropriate correction is required.

Claim Rejections - 35 USC § 112, 1st paragraph

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-62 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 1, 22 and 24 recite the limitation "... without utilizing a mask ..." The specification does not define what constitutes a mask. Applicant's figures show layers

5, 7 and 8 which can be interpreted as a mask which is utilized (by forming the recess) for electroplating the second metal to the plating seed layer. Furthermore, applicant's specification, Col. 7, Lines 4-9, states wherein a thin oxide layer is formed on the barrier layer thus acting as a mask during electroplating of the second metal to the seed layer. The specification does not describe in such a way as to enable one skilled in the art to make and/or use the invention without utilizing a mask.

Claim 3 recites the limitation "such that the layer including the nitride of tantalum is in the α -phase"; however there is no support in the specification for claimed α -phase TaN. The applicant discloses that the material for the conductive barrier layer is α -Ta, TaN/ α -Ta, α -Ta/TaN or TaN/ α -Ta/TaN (Col. 4, Lines 35-38 and Lines 50-53).

Claim 5 recites "wherein said seed layer is formed by electrolytic or electroless plating of said first metal"; however there is no support in the specification for claimed forming the seed layer by electrolytic plating of a first metal. The specification states that the seed layer is deposited by sputtering or evaporation, CVD or electroless plating (Col. 5, Line 56 to Col. 6, Line 2) but there is no mention of electrolytic plating of the copper seed layer.

Claim Rejections - 35 USC § 112, 2nd paragraph

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-62 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

As stated, claims 1, 22 and 24 recite the limitation "... without utilizing a mask ...". The manner in which the claim is written does not define what constitutes a mask. Applicant's figures show layers 5, 7 and 8 which can be interpreted as a mask which is utilized (by forming the recess) for electroplating the second metal to the plating seed layer. Furthermore, applicant's specification, Col. 7, Lines 4-9, states wherein a thin oxide layer is formed on the barrier layer thus acting as a mask during electroplating of the second metal to the seed layer. Moreover, since there are no claim limitations defining what constitutes a "mask" (i.e.: materials) any arbitrary material that is not present in a prior art teaching during the electroplating will anticipate the limitation of "without utilizing a mask", wherein the "mask" will be interpreted as the arbitrary material not present in the prior art teaching during the electroplating of the second metal.

Claim 1 recites the limitation "... removing portions of said photoresist layer and portions of said plating seed layer of said at least one recess ...". It is unclear as to what applicant means by "of said recess", whether or not the applicant intended to claim removing portions of said photoresist layer and portions of said plating seed layer **outside** of said at least one recess. There is no support for removing portions of said plating seed layer in said recess. Claim 1 further recites the limitation "... removing photoresist remaining in said at least one recess ...". There is insufficient antecedent basis for this limitation in the claim. The claim recites that the photoresist is deposited

over the seed layer but does not recite that there is ever photoresist in the at least one recess or that the seed layer is in the at least one recess for that matter.

Claim 3 recites the limitation "such that the layer including the nitride of tantalum is in the α -phase", there is no support in the specification for claimed α -phase TaN. The applicant discloses that the material for the conductive barrier layer is α -Ta, TaN/ α -Ta, α -Ta/TaN or TaN/ α -Ta/TaN (Col. 4, Lines 35-38 and Lines 50-53). In light of the teachings in the specification and for examination on the merits, the claimed conductive barrier is interpreted to be TaN/ α -Ta.

Claim 7 recites the limitation "... on said layer of tantalum ..." There is insufficient antecedent basis for this limitation in the claim. Claim 8 includes the limitations of Claim 7.

Claim 12 recites the limitation "... said portions of said photoresist layer and said seed layer outside of said recess..." There is insufficient antecedent basis for this limitation in the claim.

Claims 16, 38 and 57 recite the limitation "... (said) recesses ..." There is insufficient antecedent basis for this limitation in the claim. Furthermore, more than one recess is not shown in the figures.

Claim 30 recites the limitation "... on said layer of tantalum ..." There is insufficient antecedent basis for this limitation in the claim. Claim 31 includes the limitations of Claim 30.

Claim 49 recites the limitation "... on said layer of tantalum ..." There is insufficient antecedent basis for this limitation in the claim. Claim 50 includes the limitations of Claim 49.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 5, 6, 9, 14-17, 22, 24, 36, 38, 39 and 55 are rejected under 35 U.S.C. 102(e) as being anticipated by Efland et al. (U.S. Patent 6,025,275) hereinafter referred to "Efland".

As insofar as Claim 1 is definite Efland teaches, in Fig. 1A-1E, a method for plating a second metal directly to a first metal, said method comprising: providing a semiconductor substrate (12) including at least one metal feature (20) and at least one insulating layer (22) covering said metal feature (20) and said substrate (12) (Fig. 1A); forming at least one recess (24) in said at least one insulating layer (22) thereby exposing at least a portion of said metal feature (20) (Fig. 1A); forming at least one

conductive barrier layer (30) over said insulating layer (22) and said exposed portion of said metal feature (20) (Fig. 1B); forming a plating seed layer of a first metal (32) over said at least one barrier layer (30) (Fig. 1B); depositing a photoresist layer (40) over said plating seed layer (32) (Fig. 1B); removing portions of said photoresist layer (40) of said at least one recess (Fig. 1D; Col. 5, Lines 44-49); removing portions of said plating seed layer (32) of said at least one recess (Fig. 1E; Col. 6, Lines 41-44); removing photoresist (40) remaining in said at least one recess (Fig. 1B; Col. 5, Lines 11-19); and electroplating a second metal (50) to said plating seed layer (32) in said recess without utilizing a mask made of silicon nitride (or any other arbitrary material not present during electroplating of the second metal) for example (Fig. 1C).

As insofar as Claims 5 and 6 are definite, Efland further teaches wherein the conductive barrier (30) is provided by sputter deposition (Col. 4 Lines 39-43) on said insulating layer (22) and said exposed portion of said metal feature (20) and the copper seed layer (32) is sputter deposited on the barrier layer (30) (Col. 4, Lines 64-67).

As insofar as claim 9 is definite, Efland further teaches wherein said copper layer (32) is about 2000 Å which is within the range of 1000 Å to about 20,000 Å thick (Col. 4, Lines 64-67).

As insofar as Claim 14 is definite, Efland further teaches wherein said barrier layer (30) forms a conductor for said electroplating of said second metal (50).

As insofar as claim 15 is definite Efland further teaches wherein said second metal (50) is a platable terminal metallurgy such as copper.

As insofar as Claim 16 is definite, Efland further teaches removing said at least one conductive barrier layer (30) from horizontal portions between recesses (Fig. 1E).

As insofar as Claim 17 is definite, Efland further teaches wherein said electroplated second metal (50) acts as a mask for the removal of said at least one conductive barrier layer (30) (Fig. 1E).

As insofar as Claim 22 is definite, Efland teaches, in Fig. 1A-1E, a method for plating a second metal directly to a first metal, said method comprising: providing a semiconductor substrate (12) including at least one metal feature (20) and at least one insulating layer (22) covering said metal feature (20) and said substrate (12) (Fig. 1A); forming at least one recess (24) in said at least one insulating layer (22) thereby exposing at least a portion of said metal feature (20) (Fig. 1A); forming at least one conductive barrier layer (30) over said insulating layer (22) and said exposed portion of said metal feature (20) (Fig. 1B); forming a plating seed layer of a first metal (32) over said at least one barrier layer (30) (Fig. 1B); providing a pad (photoresist; 40) in said at least one recess (24) (Fig. 1B); removing portions of said plating seed layer (32) outside of said at least one recess (Fig. 1E; Col. 6, Lines 41-44); removing said pad (photoresist; 40; Fig. 1D; Col. 5, Lines 44-49); electroplating a second metal (50) to said plating seed layer (32) in said recess without utilizing a mask made of silicon nitride (or any other arbitrary material not present during electroplating of the second metal) for example (Fig. 1C). The Examiner notes that a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention

and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See, e.g., *In re Pearson*, 181 USPQ 641 (CCPA); *In re Minks*, 169 USPQ 120 (Bd Appeals); *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). See MPEP §2114. The recitation of "for preventing removal of portions of said seed layer in said at least one recess" does not distinguish the present invention over the prior art of Efland who teaches the structure as claimed.

As insofar as Claims 47 and 48 are definite, Efland further teaches wherein the conductive barrier (30) is provided by sputter deposition (Col. 4 Lines 39-43) on said insulating layer (22) and said exposed portion of said metal feature (20) and the copper seed layer (32) is sputter deposited on the barrier layer (30) (Col. 4, Lines 64-67).

As insofar as claim 51 is definite, Efland further teaches wherein said copper layer (32) is about 2000 Å which is within the range of 1000 Å to about 20,000 Å thick (Col. 4, Lines 64-67).

As insofar as claim 55 is definite, Efland further teaches wherein said barrier layer (30) forms a conductor for said electroplating of said second metal (50).

As insofar as claim 56 is definite, Efland further teaches wherein said second metal (50) is a platable terminal metallurgy such as copper.

As insofar as claim 57 is definite, Efland further teaches removing said at least one conductive barrier layer (50) from horizontal portions between said recesses (Fig. 1E).

As insofar as claim 58 is definite, Efland further teaches wherein said electroplated second metal (50) acts as a mask for the removal of said at least one conductive barrier layer (30).

As insofar as claim 24 is definite, Efland teaches a method for plating a second metal directly to a first metal, said method comprising: providing a semiconductor substrate (12) including at least one metal feature (20) and at least one insulating layer (22) covering said metal feature (20) and said substrate (12) (Fig. 1A); forming at least one recess (24) in said at least one insulating layer (22) thereby exposing at least a portion of said metal feature (20) (Fig. 1A); forming at least one conductive barrier layer (30) over said insulating layer (22) and said exposed portion of said metal feature (20) (Fig. 1B); forming a plating seed layer of a first metal (32) over said at least one barrier layer (30) (Fig. 1B); removing portions of said plating seed layer (32) outside of said at least one recess (Fig. 1E); and electroplating a second metal (50) to said plating seed layer (32) in said recess without utilizing a mask made of silicon nitride (or any other arbitrary material not present during electroplating of the second metal) for example (Fig. 1C).

As insofar as Claims 28 and 29 are definite, Efland further teaches wherein the conductive barrier (30) is provided by sputter deposition (Col. 4 Lines 39-43) on said insulating layer (22) and said exposed portion of said metal feature (20) and the copper seed layer (32) is sputter deposited on the barrier layer (30) (Col. 4, Lines 64-67).

As insofar as claim 32 is definite, Efland further teaches wherein said copper layer (32) is about 2000 Å which is within the range of 1000 Å to about 20,000 Å thick (Col. 4, Lines 64-67).

As insofar as claim 36 is definite, Efland further teaches wherein said barrier layer (30) forms a conductor for said electroplating of said second metal (50).

As insofar as claim 37 is definite, Efland further teaches wherein said second metal (50) is a platable terminal metallurgy such as copper.

As insofar as claim 38 is definite, Efland further teaches removing said at least one conductive barrier layer (30) from horizontal portions between said recesses (Fig. 1E).

As insofar as claim 39 is definite, Efland further teaches wherein said electroplated second metal (50) acts as a mask for the removal of said at least one conductive barrier layer (30).

Claims 1, 2, 14, 16-18, 22, 24, 25, 36, 38-40, 44, 55 and 57-59 are rejected under 35 U.S.C. 102(b) as being anticipated by Gansauge et al. (U.S. Patent 5,010,389) hereinafter referred to "Gansauge".

As insofar as Claim 1 is definite, Gansauge teaches, in Fig. 1-6, a method for plating a second metal directly to a first metal, said method comprising: providing a semiconductor substrate (10) including at least one metal feature (14) and at least one insulating layer (12) covering said metal feature (14) and said substrate (10) (Fig. 1); forming at least one recess in said at least one insulating layer (12) thereby exposing at

least a portion of said metal feature (14) (Fig. 1); forming at least one conductive barrier layer (20; Col. 5, Lines 10-14; chromium, copper and gold) over said insulating layer (12) and said exposed portion of said metal feature (14) (Fig. 1); forming a plating seed layer of a first metal (20) over said at least one barrier layer (20) (Col. 5, Lines 10-14); depositing a photoresist layer (24) over said plating seed layer (20) (Fig. 3); removing portions of said photoresist layer (24) of said at least one recess (Fig. 3-6); removing portions of said plating seed layer (20) of said at least one recess (Fig. 5 and 6); removing photoresist (24) remaining in said at least one recess (Fig. 3-6); and electroplating a second metal (36) to said plating seed layer (20) in said recess without utilizing a mask made of silicon nitride (or any other arbitrary material not present during electroplating of the second metal) for example (Fig. 4-6).

As insofar as Claim 2, Gansauge further teaches wherein said metal feature (14) is a metal last provided in said semiconductor substrate (10).

As insofar as Claim 14 is definite, Gansauge further teaches wherein said barrier layer (20) forms a conductor for said electroplating of said second metal (34).

As insofar as Claim 16 is definite, Gansauge further teaches removing said at least one conductive barrier layer (20) from horizontal portions between recesses (Fig. 5).

As insofar as Claim 17 is definite, Gansauge further teaches wherein said electroplated second metal (36) acts as a mask. The Examiner notes that a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed

invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See, e.g., *In re Pearson*, 181 USPQ 641 (CCPA); *In re Minks*, 169 USPQ 120 (Bd Appeals); *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). See MPEP §2114. The recitation of "for the removal of said at least one conductive barrier layer" does not distinguish the present invention over the prior art of Gansauge who teaches the structure as claimed. The manner in which the claim is written does not positively recite performing the step of "removing said at least one conductive barrier layer".

As insofar as Claim 18 is definite, Gansauge further teaches wherein said at least one metal feature (14) is formed in said substrate (10).

As insofar as claim 21 is definite, Gansauge further teaches wherein said second metal is a solder ball.

As insofar as Claim 22 is definite, Gansauge teaches, in Fig. 1-6, a method for plating a second metal directly to a first metal, said method comprising: providing a semiconductor substrate (10) including at least one metal feature (14) and at least one insulating layer (12) covering said metal feature (14) and said substrate (10); forming at least one recess in said at least one insulating layer (12) thereby exposing at least a portion of said metal feature (14); forming at least one conductive barrier layer (20; Col. 5, Lines 10-14; chromium, copper and gold) over said insulating layer (12) and said exposed portion of said metal feature (14); forming a plating seed layer of a first metal (20) over said at least one barrier layer (20); providing a pad (24) in said at least one

recess; removing portions of said plating seed layer (20) outside of said at least one recess; removing said pad (24); electroplating a second metal (36) to said plating seed layer (20) in said recess without utilizing a mask made of silicon nitride (or any other arbitrary material not present during electroplating of the second metal) for example (Fig. 4-6). The Examiner notes that a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See, e.g., *In re Pearson*, 181 USPQ 641 (CCPA); *In re Minks*, 169 USPQ 120 (Bd Appeals); *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). See MPEP §2114. The recitation of “for preventing removal of portions of said seed layer in said at least one recess” does not distinguish the present invention over the prior art of Gansauge who teaches the structure as claimed.

As insofar as Claim 44 is definite, Gansauge further teaches wherein said metal feature (14) is a metal last provided in said semiconductor substrate (10).

As insofar as claim 55 is definite, Gansauge further teaches wherein said barrier layer (20) forms a conductor for said electroplating of said second metal (36).

As insofar as claim 57 is definite, Gansauge further teaches removing said at least one conductive barrier layer (20) from horizontal portions between said recesses (Fig. 5).

As insofar as claim 58 is definite, Gansauge further teaches wherein said electroplated second metal (36) acts as a mask. The Examiner notes that a recitation of

the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See, e.g., *In re Pearson*, 181 USPQ 641 (CCPA); *In re Minks*, 169 USPQ 120 (Bd Appeals); *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). See MPEP §2114. The recitation of "for the removal of said at least one conductive barrier layer" does not distinguish the present invention over the prior art of Gansauge who teaches the structure as claimed. The manner in which the claim is written does not positively recite performing the step of "removing said at least one conductive barrier layer".

As insofar as claim 59 is definite, Gansauge further teaches wherein said at least one metal feature (14) is formed in said substrate (10).

As insofar as claim 62 is definite, Gansauge further teaches wherein said second metal is a solder ball.

As insofar as claim 24 is definite, Gansauge teaches a method for plating a second metal directly to a first metal, said method comprising: providing a semiconductor substrate (10) including at least one metal feature (14) and at least one insulating layer (12) covering said metal feature (14) and said substrate (10); forming at least one recess in said at least one insulating layer (12) thereby exposing at least a portion of said metal feature (14); forming at least one conductive barrier layer (20; Col. 5, Lines 10-14; chromium, copper and gold) over said insulating layer (12) and said

exposed portion of said metal feature (14); forming a plating seed layer (20) of a first metal (14) over said at least one barrier layer (20); removing portions of said plating seed layer (20) outside of said at least one recess; and electroplating a second metal (34) to said plating seed layer (20) in said recess without utilizing a mask made of silicon nitride (or any other arbitrary material not present during electroplating of the second metal) for example (Fig. 4-6).

As insofar as claim 25 is definite, Gansauge further teaches wherein said metal feature (14) is a metal last provided in said semiconductor substrate (12).

As insofar as claim 36 is definite, further teaches wherein said barrier layer (20) forms a conductor for said electroplating of said second metal (34).

As insofar as claim 38 is definite, Gansauge further teaches removing said at least one conductive barrier layer (20) from horizontal portions between said recesses (Fig. 5).

As insofar as claim 39 is definite, Gansauge further teaches wherein said electroplated second metal (36) acts as a mask. The Examiner notes that a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See, e.g., *In re Pearson*, 181 USPQ 641 (CCPA); *In re Minks*, 169 USPQ 120 (Bd Appeals); *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). See MPEP §2114. The recitation of “for the removal of said at least one conductive barrier layer” does not distinguish the

present invention over the prior art of Gansauge who teaches the structure as claimed. The manner in which the claim is written does not positively recite performing the step of "removing said at least one conductive barrier layer".

As insofar as claim 40 is definite, Gansauge further teaches wherein said at least one metal feature (14) is formed in said substrate (10).

As insofar as claim 43 is definite, Gansauge further teaches wherein said second metal is a solder ball.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3-8 and 26 are rejected under 35 U.S.C. 103(a) as being obvious over Efland et al. (U.S. Patent 6,025,275) in view of Cabral, Jr. et al. (European Patent EP 0 751 566 A2) hereinafter referred to "Cabral".

As insofar as Claims 3, 26 and 45 are definite, Efland further teaches wherein the conductive barrier (30) is provided by sputter deposition (Col. 4 Lines 39-43) on said insulating layer (22) and said exposed portion of said metal feature (20) but does not explicitly state wherein the conductive barrier is a layer of at least one nitride of tantalum and subsequent sputter deposition of a layer of tantalum on said tantalum nitride layer,

such that the layer of tantalum is in the α -phase. However, Cabral teaches forming a conductive barrier layer by sputtering TaN and then α -Ta on the TaN. Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made make the conductive barrier layer of Efland by sputtering TaN and then α -Ta on the TaN as taught by Cabral in order to provide a high integrity barrier, low stress, low resistivity, excellent adhesion and better conformality (Col. 3, Lines 9-11 and Lines 29-32).

As insofar as claims 4, 27 and 46 are definite, Efland in view of Cabral does not explicitly state wherein said tantalum nitride layer is about 10 Å to about 1000 Å thick and said tantalum layer is about 500 Å to about 5000 Å thick. It would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the thickness of the tantalum nitride layer to be about 10 Å to about 1000 Å thick and the thickness of the tantalum layer to be about 500 Å to about 5000 Å thick, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

As insofar as claims 10, 33 and 52 are definite, Efland in view of Cabral further teach wherein said tantalum is alpha tantalum.

As insofar as claims 7, 8, 30, 31, 49 and 50 are definite, Efland further teaches wherein the conductive barrier (30) is provided by sputter deposition (Col. 4 Lines 39-43) on said insulating layer (22) and said exposed portion of said metal feature (20) and

the copper seed layer (32) is sputter deposited on the barrier layer (30) but does not explicitly state wherein the conductive barrier is a layer of at least one nitride of tantalum and subsequent sputter deposition of a layer of tantalum on said tantalum nitride layer, such that the layer of tantalum is in the α -phase. However, Cabral teaches forming a conductive barrier layer by sputtering TaN and then α -Ta on the TaN. Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made make the conductive barrier layer of Efland by sputtering TaN and then α -Ta on the TaN thus providing a tantalum layer of α -Ta/TaN as taught by Cabral in order to provide a high integrity barrier, low stress, low resistivity, excellent adhesion and better conformality (Col. 3, Lines 9-11 and Lines 29-32).

Claim 13 is rejected under 35 U.S.C. 103(a) as being obvious over Efland et al. (U.S. Patent 6,025,275).

As insofar as claim 13 is definite, Efland does not explicitly state wherein said photoresist is spun on said plating seed layer. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to spin on photoresist as such is well-known and standard in the art for providing a uniform coating.

Claims 19, 41 and 60 are rejected under 35 U.S.C. 103(a) as being obvious over Efland et al. (U.S. Patent 6,025,275) in view of Gansauge et al. (U.S. Patent 5,010,389).

As insofar as claims 19, 20, 41, 42, 60 and 61 are definite, Efland further teaches wherein said insulating layer (22) includes layer of an oxide and a nitride but does not explicitly state wherein the insulating layer includes at least one layer of a polyimide. However, Gansauge teaches forming recesses in an insulating layer (22) of polyimide. Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made to incorporate the polyimide as an insulating layer as taught by Gansauge in the insulating layer structure of Efland in order to serve as an additional protective layer to the metal wiring lines below (Col. 4, Lines 31-33).

Claims 12, 35 and 54 are rejected under 35 U.S.C. 103(a) as being obvious over Efland et al. (U.S. Patent 6,025,275) in view of Akram (U.S. Patent 5,736,456).

As insofar as claims 12, 23, 35 and 54, Efland further teaches wherein said portions of said photoresist layer and said seed layer outside of said recess are removed but does not explicitly state wherein said portions are removed by chemical-mechanical polishing using a hard polishing pad. However, Akram teaches in Fig. 4a-4e, wherein portions of the photoresist layer (84) and the copper seed layer (72) outside of said recess are removed by chemical-mechanical polishing (CMP) which utilizes a hard pad (78). Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made to use the CMP method taught by Akram as the alternative to etching in order to remove the photoresist and seed layer portions outside of the recess in the device of Efland as such functional accomplishes the same goal to remove the excess photoresist and seed layer without an unexpected result.

Allowable Subject Matter

Claims 11, 34 and 53 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Telephone / Fax Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Earl N. Taylor whose telephone number is (571) 272-8894. The examiner can normally be reached on Monday-Friday from 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Loke can be reached on (571) 272-1657. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

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Examiner: Earl N. Taylor

/DAVID VU/

Art Unit: 2818

Primary Examiner, Art Unit 2818